SUB-CALIBRED PROJECTILES WITH MULTIPLE SUPPORTS

BACKGROUND OF THE INVENTION

1 - Field of invention

The technical scope of the invention is that of sub-calibred projectiles comprising a calibred sabot formed of at least two segments and surrounding a sub-calibred penetrator.

2 - Description of the related art

Such projectiles are well known and are usually termed fin-projectiles since the penetrator is stabilized using a fin tailpiece.

The sabot generally has a calibred push plate onto which a sealing band is mounted. The sabot also incorporates another calibred support seat allowing the projectile to be guided in the barrel and preventing the axis of the penetrator from becoming misaligned with respect to the barrel axis.

This other support seat may be found to the fore of the guiding plate as described hereafter with reference to Figure 1 (so-called "pull-push" sabot).

It may also be found to the rear of the guiding plate as described hereafter with reference to Figure 2 (so-called "pull" sabot).

Fin-stabilized projectiles are currently sought to have improved performances both with respect to the velocity of the penetrator and to its piercing capabilities.

An increase in the velocity may be obtained by increasing the mass of propellant charge, thereby conducting to the lead of projectiles in which the push plate is positioned far forwards.

The push plate of the sabot is thus introduced into the gun barrel well before the rear support seat is able to stabilize the sabot. There is therefore a risk during the first moments of the interior ballistic phase of the projectile pivoting around the hinge formed by the band. Such pivoting leads to the incorrect angular positioning of the

projectile in the barrel which may cause oscillations disturbing the flight stability of the projectile.

Research to improve performances also lead to the design of projectiles incorporating a very long penetrator whose rear part penetrates deeply into the propellant charge. The sabot must in this case be reinforced at its rear part so as to drive the inertia of the penetrator, thereby compromising the light weight of the sabot.

Moreover, an elongated penetrator causes bending oscillations to the rear part of the projectile in the barrel thereby also causing a disturbance to the flight stability of the projectile.

SUMMARY OF THE INVENTION

The aim of the projectile is to propose a projectile that does not suffer from such drawbacks.

Thus, the projectile according to the invention incorporates a sabot of reduced mass but which nevertheless ensures improved guidance for the projectile in the barrel and avoids positioning obliquities and vibrations of the penetrator.

Thus, the invention relates to a sub-calibre projectile comprising a calibred sabot formed of at least two segments and surrounding a sub-calibred penetrator, such projectile wherein the sabot incorporates at least three substantially calibred support seats, axially spaced from one another.

The distance between the two supports the furthest apart will preferably be greater than or equal to 3 calibers.

According to a particular embodiment at least one support seat, called the median support seat, is formed by a push plate incorporating at least one groove to receive a band, such push plate axially located between two other support seats.

Advantageously, the push plate will be positioned at a distance from a median transverse plane PM, such plane being orthogonal to the penetrator and passing through the center of gravity of the full projectile, such distance being between 0.5 and 1.5 calibers.

A forward support seat may be constituted by radial arms evenly spaced angularly around the sabot.

Each arm may carry a foot of a plastic material at its end ensuring the guidance of the sabot in the barrel.

A rear support seat may be constituted by radial studs, evenly spaced angularly around the sabot.

Each radial stud may be integral with a segment of the sabot.

Alternatively, each radial stud may be formed by the juxtaposition of two parts, each integral with a separate segment of the sabot.

Each radial stud may carry a foot of a friction resistant material, for example steel, ensuring the guidance of the sabot in the barrel.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will become more apparent from the following description of the embodiments, such description made with reference to the appended drawings, in which:

- Figures 1 and 2 show a longitudinal section of two projectiles according to prior art positioned in a gun barrel,

- Figures 3a and 3b show a longitudinal section of a projectile according to a first embodiment of the invention, Figure 3a shows the projectile positioned in the barrel and Figure 3b shows the projectile inside the barrel during firing,

- Figures 4a and 4b show a longitudinal section of a projectile according to a second embodiment of the invention, Figure 4a shows the projectile positioned in the barrel and Figure 4b shows the projectile inside the barrel during firing,

- Figure 5a and 5b show cross sections of different variant embodiment of the rear support seats,

- Figure 6a and 6b show partial longitudinal and cross sections of one embodiment of a rear support seat,

- Figures 7a and 7b show partial longitudinal and cross sections another embodiment of a rear support seat.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Figures 1 and 2 show two fin-stabilized projectiles according to prior art.

The projectile 1 shown in Figure 1 is a classical projectile incorporating a sabot 2 formed of three sectors surrounding a penetrator 4 fitted with a fin tail piece 5.

The sabot 2 incorporates a cup-shaped forward support seat 6 with a circular rim substantially of the same diameter as the gun barrel 7. The sabot 2 also incorporates a rear support seat forming a push plate PP onto which the pressure of the propulsive gases is applied.

This push plate PP incorporates a groove receiving a band 8 ensuring gas-tightness.

This sabot 2 is of the "pull-push" type, which means that the push plate PP is axially located substantially at or slightly to the rear of a median traverse plane PM which is the orthogonal plane to the penetrator 4 through the center of gravity of the full projectile.

We see that when this projectile is positioned for firing in the gun barrel the two support seats are in contact with the barrel. However, the length of the penetrator 4 still in the chamber 10 of the gun is substantial. Bending oscillations to the rear part of the penetrator will occur during firing thereby disturbing the flight stability of the penetrator. Solutions implemented to date have led to the rigidity of the rear part of the sabot being reinforced by increasing the thickness of the sabot thereby making it heavier.

The projectile 1 shown in Figure 2 has an analogous overall structure and also comprises a sabot 2 formed of three segments surrounding a penetrator 4. It differs from the previous one in that its forward support seat is constituted by the push plate PP, whereas the rear support seat is constituted by three radial studs 9 integral with the sabot 2 and substantially calibred.

Such a sabot is of the "pull" type. In fact, the push plate PP carrying the band 8 is here much to the fore of the

median traverse plane PM, orthogonal to the penetrator 4 through the center of gravity of the full projectile.

We see that when the projectile is position in the gun barrel (as shown in Figure 2), the rear support seat is in the chamber. It can only ensure its guidance function when the projectile is further inside the gun barrel. This results in the projectile pivoting around the band 8.

In both cases, the guidance length *l* which is the distance between the two supports is of around 1.5 calibers for the pull sabot projectile according to Figure 2 and 2.5 calibers for the pull-push sabot projectile in Figure 1.

A first embodiment of a projectile 1 according to the invention is shown in Figures 3a and 3b. This projectile has a "pull-push" sabot like the one in Figure 1. It differs from the latter in that the sabot 2 incorporates three substantially calibred support seats that are axially spaced from one another.

The projectile thus comprises:

- a cup-shaped forward support seat 6 with a circular rim substantially of the diameter of the gun barrel 7,
- a median support seat constituted by the push plate PP carrying the band 8,
- a rear support seat constituted by radial studs 11 evenly spaced angularly around the sabot 2.

The result of such a configuration is that when the projectile 1 is inside the barrel 7 (Figure 3b) the penetrator is held with respect to the barrel by three guiding supports (6, PP and 11).

Oscillations to the rear part of the penetrator, even for penetrators of great length (over 30 times their diameter), are avoided.

The guidance length L, that is the distance between the two supports that are the furthest apart (6 and 11) is greater than or equal to 3 calibers, that is substantially twice as long as that of prior guidance *l* (Figure 1).

The rear studs 11 have a mass that is lower than the mass of the sabot that would have been necessary at the rear part to prevent the penetrator from oscillating. The projectile

according to the invention has thus improved rigidity whilst being reduced in mass.

So as to prevent the rear studs 11 from deteriorating during the passage of the forcing cone, each stud 11 will be given a foot 14 of a resistant material, for example steel.

A second embodiment of a projectile 1 according to the invention is shown in Figures 4a and 4b. This projectile is a "pull" sabot projectile like the one in Figure 2. It differs from the latter in that the sabot 2 incorporates three substantially calibred support seats that are axially spaced from one another.

The projectile thus comprises:

- a rear support seat constituted by radial studs 9 evenly spaced angularly around the sabot 2,
- a median support constituted by the push plate PP carrying the band 8,
- a forward support seat constituted by radial arms 12 evenly spaced angularly around the sabot 2.

Each arm 12 carries a foot 13 of a plastic material at its end that ensures the guidance of the sabot in the barrel 7. Once again, the result of this configuration is that when the projectile 1 is inside the barrel 7 (Figure 4b) the penetrator is held in position with respect to the barrel by three guiding supports (9, PP and 12).

Oscillations to the rear part of the penetrator, even for penetrators of great length (over 30 times their diameter), are avoided.

The guidance length L, that is the distance between the two supports that are the furthest apart (9 and 12) is greater than or equal to 3 calibers.

Moreover, the presence of arms 12 forming the guidance support prevent the projectile from being misaligned when being set into position for firing (Figure 4b).

The distance L1 between the forward support 12 and median support PP is thus greater than or equal to 1.5 calibers.

The mass of the arms 12 is reduces and therefore does not add excessive weight to the sabot. The projectile according

to the invention thus has improved rigidity whilst be of a reduced mass.

Additionally, the push plate PP of this sabot is positioned at a distance from the median traverse plane PM (plane orthogonal to the penetrator and through the center of gravity of the full projectile) that is between 0.5 and 1.5 calibers.

Such an arrangement allows the sabot's mass to be optimized. Thus, the push plate PP of the projectile is forward of the gun's forcing cone 16 when the ammunition is set into the firing position.

Computations will verify that the optimal gain in mass for a 120 mm calibre sabot is obtained by moving the push plate forward by around 80 mm with respect to its usual position at the forcing cone 16. This results in a reduction is the weight of the sabot of 15 to 20% for an analogous production cost.

It will be possible for the arms 12 to be given a pocket-shaped profile to receive the aerodynamic flow upon exiting the weapon. Such an arrangement allows the separation of the sabot segments to be separated upon exiting the gun barrel. So as to prevent the rear studs 9 from deteriorating during the passage of the forcing cone 16, each stud 9 will be given a foot 14 of a resistant material, for example steel.

Figures 5a and 5b show a cross section of two variant embodiments of the rear supports 9 or 11.

Each radial stud 9 or 11 forming the rear support may thus be integral with a single segment 2a, 2b or 2c of the sabot 2 as shown in Figure 5a.

Alternatively, each radial stud 9 or 11 may be formed by the juxtaposition of two parts, each integral with a separate segments of the sabot 2a, 2b or 2c, as shown in Figure 5b.

Each rear radial stud 9 or 11 will preferably be given a foot 14 of resistant material, for example steel, that will ensure the guidance of the sabot in the barrel.

Figures 6a and 6b thus show the rear studs 9 or 11 provided with feet 14 made in the form of screws introduced into female threadings carried in the studs 9 or 11.

Figures 7a and 7b show the rear studs 9 or 11 provided with feet 14 that are all made in the form of pads with a dove-tailed base 15 cooperating with a matching-shaped groove arranged in the extremity of the stud 9 or 11.

It is naturally possible for a projectile incorporating more than three support seats to be designed. It is also possible for a projectile incorporating three support seats in which the push plate carrying the band constitutes the foremost or rearmost support.